DISCUSSION PAPERS IN ECONOMICS

Working Paper No. 02-03

Endogenous Gender Power, Household Labor Supply and the Quantity-Quality Tradeoff

Murat F. lyigun Department of Economics, University of Colorado at Boulder Boulder, Colorado

Randall P. Walsh Department of Economics, University of Colorado at Boulder Boulder, Colorado

July 2002

Center for Economic Analysis

Department of Economics



University of Colorado at Boulder Boulder, Colorado 80309

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Murat F. Iyigun murat.iyigun@stripe.colorado.edu

> Randall P. Walsh walshr@colorado.edu

University of Colorado, Boulder

Abstract

We present a microeconomic model of the household under which there exists no difference in spousal preferences but where childrearing is more time costly for women. Bargaining between the wife and the husband forms the basis of household decisions. Marital bargaining power is determined endogenously according to the relative labor income of the spouses. The endogeneity of bargaining power introduces a non-cooperative element to the couples' decision-making problem because both the husband and the wife take into account how their labor supply decisions affect their marital power and the share they extract from household resources. Under the model, changes in marital gender power influence the quantity-quality tradeoff because the intra-household transfers of leisure affect the marital balance of power. Our model shows that empowering women through institutional reforms leads to lower fertility and higher educational attainment. Improvements in life expectancy and a lower gender wage gap are also shown to empower women and divert household resources to education.

Keywords: Fertility, Education, Gender Gap, Bargaining. JEL Classification Numbers: J13, O11, O33, O40.

For useful comments and suggestions, we thank Ann Carlos, Yongmin Chen, Moshe Hazan, Omer Moav, Roberto Rigobon, Jack Robles, Thomas Rutherford, David N. Weil and participants of the 2002 Econometric Society Summer Meetings. Please send all correspondence to Murat Iyigun, University of Colorado at Boulder, Department of Economics, Campus Box 256, Boulder, CO 80309-0256. Phone: (303) 492-6653. Fax: (303) 492-8622.

1. Introduction

The allocation of resources within the family, in general, and household choices regarding the quantity and quality of offspring, in particular, are marital decisions that potentially influence the economic development process. Economists have traditionally modelled these marital decisions using unified models of the household where by design differences between the spouses are ignored. Yet there are inherent biological differences between the sexes in the requirements of parental time investment.¹ While these differences are most pronounced in the earlier stages of reproduction, during which the time and energy consumed for child birth is far greater for women than they are for men, there is evidence to suggest that the disparity continues after birth.² Hence, it is quite natural for this biological disparity to manifest itself in a potential marital conflict over optimal fertility and the quantity-quality tradeoff. Coupled with a departure from the unitary model of the household, the existence of such gender differences render marital decision-making power relevant for the process of economic development.

This paper focuses on the role of these gender differences in intra-household bargaining and the quantity-quality tradeoff. It presents a model of the household where there exists no difference in spousal preferences but where child rearing is more time costly for women. Bargaining between the wife and the husband forms the basis of household decisions. Marital bargaining power is determined endogenously according to the relative labor income of the spouses. The endogeneity of bargaining power introduces a non-cooperative element to the couples' decision-making problem since both partners take into account how their labor supply decisions affect their marital power and the share they extract from household resources.

Even when spouses exhibit identical preferences, as they do below, changes in marital gender power are shown to influence the quantity-quality tradeoff. In essence, what generates a quality-quantity tradeoff is labor-leisure choice in the presence of endogenous gender power. When, as is traditionally the case, gender power is exogenously determined, household choices regarding fertility and education are independent of the bargaining power of the spouses as intra-household transfers enable couples to reach efficient outcomes, and leave the fertility-education decision unchanged. When, however,

 $^{^{1}}$ Trivers (1972) and Wright (1994).

 $^{^{2}}$ See, for instance, Wright (1994).

spouses derive utility from leisure *and* bargaining power is endogenous with respect to relative spousal incomes, the existence of leisure transfers between the spouses are not sufficient to leave household choices unaffected. This is due to the fact that spousal transfers of leisure, unlike those of consumption, affect the household balance of power. As a consequence, shifts in gender power entail changes in fertility and educational attainment.

The model presented below demonstrates that empowering women-through institutional reforms or a closing of the gender wage gap-leads to lower fertility and higher educational attainment. Improvements in life expectancy also help to empower women: when life expectancy is relatively low, the effective labor supply of women is significantly lower than that of men due to the amount of time allocated to child rearing. With endogenous bargaining power based on effective wage incomes, this generates an equilibrium where household behavior is characterized by an emphasis on quantity. As life expectancy improves, however, the relative labor supply of women increases. This in turn raises their intra-household bargaining power, which manifests itself in lower fertility and higher average education.

The main contribution of this paper is to highlight why and how marital bargaining in the presence of endogenous gender power influences the marital decision making process. The intra-household bargaining framework has been utilized by development and labor economists to address other issues pertinent to the process of development, such as female labor supply, intra-household transfers, child labor and so on.³ However, there does not yet exist an evaluation of how such a framework-together with inherent biological differences between the sexes and changes in life expectancy-can help to explain changes in the quantity-quality tradeoff. This is precisely the gap this paper intends to fill. By attempting to do so, it yields several interesting insights into how marital dynamics interact with the processes of economic growth and development.

First, biological differences between men and women in the requirements of parental time investment relate marital power sharing arrangements to the economic development process. The reason for this is that, ceteris paribus, higher time costs lead women to prefer a lower number of higher quality offspring relative to men. Thus, the extent to

³Please refer to Section 3 for a survey of the related literature.

which wives' preferences are reflected in family decisions is intricately linked to economic development.

Second, changes in life expectancy and the gender wage gap alter marital decisions, which in turn impact the processes of growth and development. Ceteris paribus, a lower wage gap levels the marital playing field by leading to higher female labor force participation rates and more marital power for the wives. Improvements in life expectancy, coupled with women's higher child rearing time costs, raise women's effective labor supply more than that of men's. Consequently, higher life expectancy eventually benefits wives relatively more and tilts the future marital balance of power in favor of womenwho are biologically more inclined to have fewer but more educated children. Hence, this result identifies an important, indirect, and gender-specific channel through which life expectancy impacts economic development.⁴

Third, the degree to which an economy is culturally predisposed towards gender equality is important. This is simply due to the fact that the transfer of power from men to women in household decision-making is by itself growth-enhancing. And as the model below will show, the existence of cultural or ideological obstacles for such a transfer can limit the impact of improved life expectancy or higher labor force participation by women on economic growth and development.

2. Historical Facts

In the late-19th and early-20th centuries, Industrialized countries entered a "demographic transition" era during which educational attainment began to rise rapidly, and-contrary to Malthusian predictions-population growth started to slow down and decline. Partly as a consequence, standards of living in the Western Hemisphere have risen at unprecedented rates since the turn of the 20th century.⁵

During this demographic transition, households underwent significant changes in terms of relative wage earnings, division of labor, the degree of specialization, and the

⁴For the recent and expanding literature on the direct effects of health on growth, see Weil (2001), Bloom, Canning, and Sevilla (2001).

⁵Conservative estimates show, for example, that the average income in the United States rose tenfold in the last 125 years. Sharp increases in educational attainment, improvements in life expectancy, and significant declines in fertility and mortality also characterized this period of rapid wealth accumulation in "Industrialized countries."

balance of power between the sexes. Boserup (1970, pp. 49, 212-213) documents that women's education relative to men, their labor force participation, and value in marriage– as measured by pride or dowry payments–all follow a U-shaped pattern throughout the process of economic development. For example, she states, "In primitive communities, the difference in productivity between male and female labor is not very large. Although most men have the advantage of superior physical strength, at this stage neither men nor women can benefit from specialization. The gap in productivity between the two sexes widens considerably at the stage when boys get some systematic training in schools or in workshops, while girls continue to be taught only by their mothers. At a later stage, when girls also go to school, the gap is reduced..."

With respect to wives' work and their marital influence, Boserup describes how women's involvement in agricultural production declines as technologies employed in agriculture become more sophisticated. She notes, "In South and East Asia, the connection between the work of women and the direction of marriage payments is close and unmistakable. For instance, in Burma, Malaya and Laos women seem to do most of the agricultural work and bride prices are customary. The same is true of Indian tribal people, and of low-caste peoples whose women work. By contrast, in Hindu communities, women are less active in agriculture, and instead of a bride price being paid by the bridegroom, a dowry has to be paid by the bride's family. A dowry paid by the girl's family is a means of securing her a good position in her husband's family."

Along the same lines, Goldin (1990) finds that the U. S. labor force participation rates first declined over a period beginning in the late 18th century and then started to rise in the mid 20th century. She also documents that the relative wages of women began to rise in the early 19th century and continued to do so at a rapid pace throughout the 20th century.

Table 1 and Figure 1 illustrate the rapidity with which life expectancy, women's labor force participation rates—most conspicuously of married women—and the women to men earnings ratio rose in the United States during the last century and a half. Between 1870 and 1990, women's expected years of schooling more than doubled, reaching 16 years from less than 8 years. As shown in Figure 1, higher educational attainment is correlated with the rise in women's relative earnings during the 20th century. Table

2 shows the gender gap in educational attainment by country income groups. While the gender gap in education narrowed across all but the high-income countries between 1980 and 1993, the lowest female enrollment rates in both the primary and secondary education levels were in South Asia, Middle East and North Africa.

[Tables 1 and 2 and Figure 1 about here.]

Our approach suggests that such changes and the demographic transition to slower population growth and higher educational attainment are interlinked due to the effects, in particular, of higher life expectancy and a narrower gender wage gap on the marital balance of power.

3. Related Literature

This paper sits at the juncture of three strands in the economic literature. The first strand is on household choices regarding fertility and educational attainment. This work includes microeconomic models of household demand formulated by Becker (1960), where a unitary framework is utilized to analyze family choices regarding the optimal quantityquality tradeoff. As mentioned in the introduction, the unitary approach to household behavior does not allow for differences in preferences or constraints to affect the decisions families make.

The second strand in the literature that this work is related to includes "collective" household models, and early- and late-generation marital bargaining models. These allow for differences between spouses to affect the choices households make by relying on a sharing-rule or an intra-household bargaining mechanism. The common result that emerges from this strand is that family members with potentially different preferences make Pareto-efficient household decisions. Among the earliest examples of the collective models are Becker (1981) and Chiappori (1988, 1992), and those of exogenous marital bargaining are Manser and Brown (1980), McElroy and Horney (1981), and Sen (1983). All of these models, however, assume that the sharing rule or the bargaining power of the two sexes are determined exogenously and that couples have different preferences over the choice sets. Basu (2001) suggests a model that treats the bargaining power of the sexes as

determined endogenously according to actual relative earnings. However, while allowing for endogenously determined bargaining power, his approach assumes that both parties treat bargaining as exogenous in the determination of their labor supply. These papers maintain spousal differences in preferences to address a wide range of microeconomic issues such as female labor supply, fertility, the prevalence of child labor and so on. Our work is most related to Basu because of the endogenous nature of marital bargaining in both models. Our model differs from Basu's, however, in three important aspects: First, we specifically address the role of endogenous bargaining in the quantity-quality tradeoff. Second, we do not consider gender differences in preferences. Instead, we explore whether the combination of endogenous gender power and differential requirements of parental time investment plays a role in educational attainment and fertility. We also assume that agents recognize the endogeneity of bargaining power.

Finally, this work is related to papers that address various aspects of demographic change and economic development in the long run. A non-exhaustive list includes Becker, Murphy and Tamura (1990), Galor and Weil (1996, 2000), Galor and Moav (1999, forthcoming), Moav (2002), Greenwood, Seshadri, and Yorukoglu (2001), Hansen and Prescott (2000), Jones (2001), and Iyigun (2000, 2001). The present effort is most related to two of these: Galor and Weil (1996) explore how skill-biased technological change induces women–who are full-time stay home moms when the return to skills is relatively low–to eventually join the labor force. They show that such a change in women's labor supply leads to lower fertility and faster growth. Greenwood, Seshadri, and Yorukoglu (2001) examine how the variety of durable consumer goods might affect household specialization and the female labor supply. Utilizing a model of household production, they show that the rapid expansion of durable consumer goods at the turn of the 20th century can account for the subsequent rise of married female labor-force participation.

The work below is motivated in large part by the desire to account for the role of marital power sharing in the determination of the quantity-quality tradeoff. In the context of dynamic models like those noted above, the interplay of marital decisionmaking and social attitudes towards gender equality is pivotal to the path of growth and development. In addition, by endogenizing the intra-household bargaining power, we not only show how the process of marital decision-making is altered to include a non-cooperative element, but also identify the inextricable links among marital gender dynamics, life expectancy, and the quantity-quality tradeoff.

4. The Building Blocks

The model rests on the following assumptions:

I) Parents value leisure as well as the quantity and quality of offspring. Individuals in this model operate in the Beckerian mold.⁶ Their utility is derived from their own consumption and leisure as well as the quantity and quality of their offspring. In line with the standard Beckerian approach to household fertility, individuals decide the optimal number of their children and the education level of each subject to a budget constraint that reflects the allocation of time between work, leisure, and child rearing.

II) The time cost of child rearing is higher for women. By assumption, the time cost of child rearing is greater for women than it is for men. There exists a strong biological basis for this assumption. Trivers (1972) was the first to identify the imbalance of time investment between the two sexes to focus on patterns of sexual behavior and social interactions. Elaborating on this point, Wright (1994, p. 42) states, "Parental investment includes the time and energy consumed in producing an egg or a sperm, achieving fertilization, gestating or incubating the egg, and rearing of the offspring. Plainly, females will generally make the higher investment up until birth, and, less plainly but in fact typically, this disparity continues after birth." And in exploring the sources of the gender gap in training and formal education in developing countries, Boserup (p. 144) finds, "Criticism of this system of providing training only for men and leaving all women workers in the low wage categories is usually met, from the employers' side, by the argument that women can be expected to spend a shorter span of years in the industry, because most of them leave around the time of marriage and childbirth."

III) Household decisions are made based on an endogenous balance of power. A novelty of what is presented below is its departure from the unitary model of household in examining the quantity-quality tradeoff. A number of papers have emphasized the "collective" view of the household in other contexts.⁷ This view recognizes that men and women who make

 $^{^{6}}$ Becker (1981).

⁷A partial list of such papers would include Manser and Brown (1980), McElroy and Horney (1981), Sen (1983), Chiappori (1988, 1992), Bourguignon and Chiappori (1994), Udry (1996) and Basu (1999).

up households can differ in their preferences, and that household choices reflect not only these differences but also the bargaining power of the two sexes. The crucial feature of our model is the endogenous determination of the marital power of both spouses. In particular, we assume that the relative bargaining power of women is related to how large a share of the total household income they earn in the labor market.

IV) Spouses choose their labor supply non-cooperatively, recognizing how their choices impact the household balance of power. With the marital balance of power being determined endogenously according to spousal incomes, rational individuals take into account how their labor supply decisions impact—via the bargaining process—the household decisions about consumption, leisure, fertility and education. This sets up a two-stage decision problem: In the first stage, couples play a pure Nash equilibrium. They choose their labor supply recognizing how their choice will interact with that of their spouses in determining the allocation of household resources in the second stage. In the second stage, couples decide their respective consumption and leisure levels as well as how many children to have and how much to educate each, taking as given each partner's labor supply. Thus, conditional on the endogenously determined bargaining weights, household resources are allocated according to the Beckerian model.⁸

In the following section, we incorporate these assumptions into a microeconomic model of the household to show how endogenous bargaining influences the quantityquality tradeoff. In Section 6, we summarize the model's main implications. And in Section 7, we conclude.

5. The Model

The economy is made up of two overlapping generations. The old (generation 1) and the young (generation 2). In both generations, half the population is male and the other half is female. Within each gender group, people are identical. Households are made up of a

See Basu (2001) for a more complete list.

⁸If one were to accept that, in general, career related decisions precede marriage and decisions that are clearly maritally oriented (such as the number of children, their average education level, and the relative consumption and leisure of the spouses during marriage), the natural sequence of events would also help to justify the two-stage game. It would suggest that, during the first stage, spouses choose their labor supply non-cooperatively but in anticipation of the impact of their choices on marital outcomes that would be determined in cooperative fashion during the second stage.

husband, a wife (of generation 1), and children (of generation 2). Thus, each individual has two parents: a mother and a father. In each household, there are equal numbers of female and male offspring. The young consume a fraction of their parents' time. The required amount of time increases in the total number of offspring the parents choose to have. The old live p, 0 , fraction of their potential unitary time endowment. $The wage rate per unit of labor equals <math>w_i$ where the subscript index i, i = f, m, denotes the gender of person i-i.e., f for female and m for male.⁹ The human capital level of the old generation, h_1 , is normalized to one. Thus, a couple can generate $p(w_f + w_m)h_1 =$ $p(w_f + w_m)$ amount of potential household income.

5.2.1. Preferences and Budget Constraints

The old generation's preferences are defined over consumption, leisure, and the quantity and quality of their children. Let c_i and l_i denote the consumption and leisure of individual *i* of the older generation. And let *n* and *h*, respectively denote the number of *i*'s children and their average human capital level. Preferences of *i* are represented by the following inter-temporal utility function:

$$U_i = \ln l_i + \alpha \ln c_i + \beta \ln n + \gamma \ln h; \qquad i = f, m. \tag{1}$$

where α , β , and γ respectively measure the values associated with consumption, the number of offspring, and their average quality as measured by the offspring's human capital. Note that (1) reflects no difference between the two sexes in preferences.

Let $\theta, \theta \in [0, 1]$, denote the marital bargaining power of women. Given θ , and the utility specification in (1), each couple maximizes the following:

$$- = \theta U_f + (1 - \theta) U_m$$

$$= \theta (\ln l_f + \alpha \ln c_f) + (1 - \theta) (\ln l_m + \alpha \ln c_m) + \beta \ln n + \gamma \ln h$$
(2)

⁹We allow the wage rates paid to men and women to potentially differ in order to explore the effects of changes in the gender wage gap on household dynamics.

Following the standard Beckerian model of household fertility, families decide the optimal number of their children and the education level of each subject to a budget constraint that reflects the allocation of time between work, leisure, and child rearing. To formalize, let τ_i , i = f, m, denote the time costs of rearing one child. Given the assumption that the time cost of child rearing is greater for women, we have $\tau_f \equiv \tau > \tau_m \equiv 0.10$ Then, for the wife and the couple, τn denotes the total time cost of child rearing.

In order to employ a relatively simple human capital accumulation process, we assume that each young person's human capital is determined in the following specific way:

$$h = \lambda + \phi e, \tag{3}$$

where ϕ denotes the marginal return to education and e is the level of education of the offspring. According to (3), if the young receive no education their human capital equals that of the unskilled λ , $\lambda \geq 0$. Attaining an education level of e does not involve any time cost but it requires a pecuniary cost of z, z > 0, per unit and a fixed start-up cost of eF, F > 0. Accordingly, e(F + zn) denotes the total cost of education per household.¹¹

A husband and wife allocate the sum of their potential income to consumption, leisure, and child rearing and education. Thus, they jointly face the following budget constraint:

$$c_f + c_m + e(F + zn) \le w_f s_f + w_m s_m \tag{4}$$

where s_f denotes the wife's labor supply and s_m that of the husband's.

¹⁰The assumption that the time cost of child rearing is zero for men is made purely for convenience. The qualitative nature of the results below remains intact as long as $\tau_f > \tau_m$.

¹¹Our main results are not driven by the inclusion of fixed education costs in our formulation. The qualitative nature of our results remain valid under specifications where education has only variable costs and no fixed costs. However, there exist interior solutions for fertility and education over a wider range of parameter choices when educational attainment involves fixed costs as well. And, as we shall demonstrate below, highlighting the roles of life expectancy and the social propensity for gender equality in household bargaining and marital choices requires us to cover a wider parameter range.

5.2.2. Exogenous Household Bargaining and the Quantity-Quality Tradeoff

For comparison, we start by considering the model with exogenously determined bargaining power. Households maximize (2) by choosing the number and education of their offspring, and the consumption level and leisure time of the wife and the husband. Hence,

$$\{c_f, c_m, l_f, l_m, s_f, s_m, n, e\} = \arg \max -$$
(5)

subject to the human capital accumulation technology, (3), the budget constraint, (4), and

$$(c_f, c_m, l_f, l_m, s_f, s_m, n, e) \ge 0,$$
 (5.a)

$$\tau n + l_f + s_f \le p, \tag{5.b}$$

$$l_m + s_m \le p. \tag{5.c}$$

To begin, assume that the bargaining parameter θ is exogenous and fixed at $\overline{\theta}$. We can use the constraints (5.b) and (5.c) to substitute in equation (4) for the labor supply of the spouses, s_f and s_m . We can then express husband's consumption, c_m , as a function of the wife's consumption, leisure, fertility and education, c_f , l_f , l_m , n, e, and substitute in for c_m in equation (2). Hence, our first-order conditions with respect to c_f , l_f , l_m , n, and e respectively satisfy the following:

$$\frac{\bar{\theta}}{c_f} = \frac{1-\bar{\theta}}{c_m} \tag{6}$$

$$\frac{\bar{\theta}}{l_f} = \frac{\alpha(1-\bar{\theta})w_f}{c_m} \tag{7}$$

$$\frac{1}{l_m} = \frac{\alpha w_m}{c_m} \tag{8}$$

$$\frac{\beta}{n} = \frac{\alpha(1-\theta)(\tau w_f + ze)}{c_m} \tag{9}$$

$$\frac{\gamma\phi}{\lambda+\phi e} \leq \frac{\alpha(1-\bar{\theta})(F+zn)}{c_m} \tag{10}$$

where

$$c_m = w_f(p - \tau n - l_f) + w_m(p - l_m) - e(F + zn) - c_f .$$
(11)

Functional form assumptions imply that interior solutions with respect to all arguments, except the education of the offspring, e, exist. An interior solution with respect to education, e, may not exist if the education premium, ϕ , is sufficiently small. In that case, couples choose not to educate their children. But if the education premium is high enough to guarantee an interior solution with respect to all arguments, we can combine (7) with (8) and (9) with (10), to find that

$$\frac{\bar{\theta}}{w_f l_f} = \frac{(1-\bar{\theta})}{w_m l_m} \tag{12}$$

and,

$$\frac{\beta(F+zn)}{n(\tau w_f+ze)} = \frac{\gamma\phi}{\lambda+\phi e}$$
(13)

At the optimum, equations (6) and (12) suggest that the bargaining power weighted marginal utilities of the husband and the wife–both from consumption and leisure–are equal. (13) shows that the marginal utilities of the quantity and quality of offspring are also equal.

Furthermore, it can be shown that, when bargaining power is exogenously determined, couples choose the optimal number and education of their offspring independent of their relative bargaining power. Put differently, changes in the balance of power alter couples' relative supply of labor and their consumption and leisure without affecting the quantity and quality of their offspring. This observation leads to our first remark: **Remark 1:** With exogenous bargaining power, optimum household fertility and education are independent of the bargaining parameter $\bar{\theta}$.

$$\frac{\partial n}{\partial \bar{\theta}} = \frac{\partial e}{\partial \bar{\theta}} = 0.$$

Proof: See Appendix.

5.2.3. Endogenous Bargaining Power and the Quantity-Quality Tradeoff

When gender power is endogenously determined, both spouses recognize that their laborleisure choice, as well as that of their partner's, impacts household allocation decisions. As a result, they choose how much to work acknowledging how the relative spousal supply of labor-via its impact on household bargaining-subsequently influences consumption, leisure, fertility and education. Thus, we have a two-stage problem: In the first stage, couples play a pure Nash equilibrium. They choose their labor supply recognizing how their choice will interact with that of their spouses in determining the allocation of household resources in the second stage. In the second stage, couples decide their respective consumption and leisure levels as well as how many children to have and how much to educate each, taking as given each partner's labor supply.

We endogenize the bargaining power variable θ by assuming that it is a function of each spouse's labor income, $w_f s_f$ and $w_m s_m$, and a parameter ψ that reflects the social and cultural attitudes towards gender equality. We assume that the bargaining power variable θ is determined by the labor income of women relative to that of men (more on which below) according to the following specification:

$$\theta = \frac{w_f s_f}{w_f s_f + \psi w_m s_m} , \qquad (14)$$

where as noted above ψ represents the relative importance of husbands' earnings in determining the household balance of power. Note that for equal levels of spousal income,

there is an equal balance of power (i.e. θ equals 1/2) only if ψ equals one. If ψ is larger than one, then the husbands have more household gender power even when the spouses have identical incomes. One can interpret ψ to be an inverse measure of the social propensity for gender equality. Equation (14) suggests that reductions in the parameter ψ , a closing of the gender wage gap, $w_m - w_f$, and higher life expectancy, p, which given the specifications in (5'.b) and (5'.c) benefit women more relative to men, all alter the marital balance of power.

To solve for the equilibrium outcome, we begin with the second stage during which couples make household choices taking as given each other's labor supply. Formally, $\{c_f, c_m, l_f, l_m, n, e\} = \arg \max$ - subject to (2), (14), and the following:

$$c_f + c_m + e(F + zn) \leq w_f \bar{s}_f + w_m \bar{s}_m \tag{4'}$$

$$(c_f, c_m, l_f, l_m, n, e) \ge 0,$$
 (5'.a)

$$\tau n + l_f + \bar{s}_f \le p, \tag{5'.b}$$

$$l_m + \bar{s}_m \le p, \tag{5'.c}$$

$$s_f = \bar{s}_f$$
 and $s_m = \bar{s}_m$. (15)

Given that the husband's labor supply is fixed at \bar{s}_m , (5'.c) fixes husband's leisure l_m at $p - \bar{s}_f$. We can use (4') and (5'.b) to respectively substitute for husband's consumption, c_m , and the wife's leisure, l_f , in equation (2). Then, our three first-order conditions with respect to the wife's consumption, c_f , optimal fertility, n, and education level, e, are given by

$$\frac{\theta}{c_f} = \frac{1-\theta}{c_m} \tag{16}$$

$$\frac{\beta}{n} = \frac{\tau\theta}{p - \tau n - \bar{s}_f} + \frac{\alpha(1-\theta)ze}{c_m} , \qquad (17)$$

$$\frac{\gamma\phi}{\lambda+\phi e} \leq \frac{\alpha(1-\theta)(F+zn)}{c_m} , \qquad (18)$$

where $c_m = w_f \bar{s}_f + w_m \bar{s}_m - e(F + zn) - c_f$. Using (16), we substitute for c_f in the preceding equation for c_m . Then we establish $c_m = (1 - \theta)[w_f \bar{s}_f + w_m \bar{s}_m - e(F + zn)]$. Substituting this into (17) and (18) we conclude that the endogeneity of bargaining power θ affects the first-order condition with respect to fertility. The first-order condition with respect to education, now given by (18), remains relatively unchanged and is not directly a function of θ . As we shall show below, however, how much to educate the offspring can be affected by θ indirectly, as spouses' labor supply is influenced by the bargaining variable θ .

Equations (16), (17), and (18) implicitly define the optimal consumption of the wife and the husband, c_f^* and c_m^* , household fertility, n^* , educational attainment, e^* , and the wife's leisure, l_f^* , as functions of the couples' labor supply decisions. Hence, we have

$$c_f^* = c(s_f, s_m),$$
 (19)

$$c_m^* = c(s_f, s_m),$$
 (20)

$$n^* = n(s_f, s_m),$$
 (21)

$$e^* = e(s_f, s_m),$$
 (22)

$$l_f^* = p - \tau n^*(s_f, s_m) - s_f, \qquad (23)$$

$$l_m = p - s_m. \tag{24}$$

We can now turn to the first stage during which the husband and wife choose their labor supply taking as given the labor supply decisions of their spouse and the determination of optimal household choices listed above. Both the husband and wife play a Nash-equilibrium game taking each other's labor supply decisions as given. Accordingly, we define the response function for individual i as a function of the labor supply of the spouse as in equation (25):

$$s_i(s_{-i}) = \arg \max U_i(s_i | \bar{s}_{-i})$$

$$= \arg \max \left[\ln l_i^* + \alpha \ln c_i^* + \beta \ln n^* + \gamma \ln(\lambda + \phi e^*) \right]; \quad i = f, m.$$

$$(25)$$

Given that the optimal values of e^* , n^* , c_m^* , c_f^* , l_m^* , and l_f^* are functions of the spouses' labor supply, s_f and s_m , the solution to (25) implicitly yields two response functions: $s_f = s(s_m)$ and $s_m = s(s_f)$. We can now define the household equilibrium:

Definition: A household equilibrium is such that

$$s_{f}^{*} = s(s_{m}^{*}) \quad \text{and} \quad s_{m}^{*} = s(s_{f}^{*}) ,$$

$$\theta^{*} = \frac{s_{f}^{*}}{s_{f}^{*} + \psi s_{m}^{*}} ,$$

$$c_{f}^{*} = c(s_{f}^{*}, s_{m}^{*}) , \quad c_{m}^{*} = c(s_{f}^{*}, s_{m}^{*}) ,$$

$$n^{*} = n(s_{f}^{*}, s_{m}^{*}) , \quad e^{*} = e(s_{f}^{*}, s_{m}^{*}) ,$$

$$l_{f}^{*} = p - \tau n^{*} - s_{f}^{*} , \quad \text{and} \quad l_{m}^{*} = p - s_{m}^{*} .$$

$$(26)$$

In Figure 2, we illustrate the response functions of the wife and the husband. We also depict how these response functions react to institutional changes that empower women (i.e. to a drop in the male marital power parameter ψ). As shown, a reduction in ψ from 3 to 1 makes the labor force participation of the spouses more equal as women reduce their labor supply and men raise theirs. The reason for this is that, when the

exogenous marital power of husbands drops, women can work less and still yield more marital power.¹² The opposite is true for men who need to work more to offset the effect on bargaining of a drop in their exogenous marital power. In Figure 3, we illustrate how the spousal response functions shift due to higher wages for women. As shown, husbands are now willing to work less and lose some marital power. This is due to the fact that higher wages for women not only tilt the marital balance of power in favor of women, but also raise the household income (with the higher household income potentially benefiting husbands). In Figure 4, we show how an improvement in life expectancy p affects the equilibrium. An exogenous improvement in life expectancy helps to raise the labor supply of women relative to that of men. Here, women work relatively more in order to capitalize on the benefit higher life expectancy provides them in the household allocation of consumption and leisure.

[Figures 2, 3, and 4 about here.]

5.2.4. Numerical Solution and Comparative Statics

Due to its inherent complexity, our model does not yield analytical solutions. However, the formulation we present here lends itself nicely to numerical analysis, and in what follows, we present a variety of computational exercises to characterize the equilibrium.¹³ We present two distinct sets of simulations: In the first set, we employ the most parsimonious specification of the theoretical model outlined above to show that endogenous bargaining power does matter for household choices regarding work, leisure, fertility and educational attainment. In the second set of computations, we utilize a more restrictive version of our model to elaborate on the interactions of changes in life expectancy and the gender wage gap with household choices regarding labor supply, leisure, and the

¹²While this may seem counter-intuitive, it is a manifestation of the change in the household equilibrium from one interior solution to another. Unlike a case in which female empowerment helps to liberate women so that they can start to work, the example we consider here does not involve a corner solution. As a consequence, women can and do lower their labor supply in response to an increase in their marital power. Further, the fact that wives choose to work more than husbands in the example depicted in Figure 2 does not apply in general, as it is an artifact of the parameters we have chosen.

¹³The GAMS code underlying our numerical exercises is available upon request.

quantity-quality tradeoff.

In all simulations, parameter values such as the wage per efficiency units of labor, w, the human capital level of unskilled labor, λ , and the education premium, ϕ , are chosen for convenience. We set the arbitrary value of such variables either equal to unity or to some other reasonable level that yields an implied population growth rate that is relatively sustainable.¹⁴ For a limited set of parameter values, however, we can rely on empirical restrictions. For example, we work with a two-period model where the first period corresponds to childhood, and the second period to adult life, during which individuals procreate and work. Hence, we can interpret the first period to be roughly equal to 15-20 years, and the second and final period to range from a low of 10-15 years to 55-60 years.¹⁵ Accordingly, given that life expectancy equals 1 + p, the length adulthood relative to childhood, p, ranges from a low of about 0.5 to a high of 3. The time cost of child rearing, τ , is similarly chosen: Medical evidence suggests that the onset of menopause has stayed relatively constant over time, despite rapid improvements in life expectancy and declines in the age at which menstrual cycles begin. A range of .05 to .1 for τ would yield a maximum of between 10 to 20 children per household, consistent with the notion that women need to spend roughly a year of their adulthood to bear and rear an infant.

The top panel of Table 3 presents the parameter values for the initial set of computations. Here we assume that educational attainment involves only variable costs (z > 0 and F = 0). We also assume that the human capital level of unskilled labor, λ , is equal to zero. With these first set parameter restrictions, we examine the role of female empowerment on household choices.

[Table 3 about here.]

Given the determinants of intra-household bargaining power, female empowerment can come about in two ways: Indirectly, due to reductions in the gender wage gap

¹⁴Since n denotes the number of offspring per household, the growth rate of population that yields a sustainable population level is equal to 2.

¹⁵This interpretation would be consistent with the evidence provided by Hanies and Steckel (2000) which shows that life expectancy roughly doubled between 1850 and 1990. See Table 1.

or higher life expectancy. And directly, as a result of policies aimed at reducing the male intra-household power parameter ψ . For given levels of relative spousal incomes, a lower value of ψ presumably captures a change in marital laws or social policies in favor of women. Or a lower value of ψ may reflect the impact of exogenous events, like improvements in contraceptive technologies that enable women to exercise more power in marriage, on the household balance of power.

In Table 3, we consider the effects of both direct and indirect female empowerment on the household equilibrium. The first two columns, (a) and (b), show the effects of a reduction in ψ . In column (a), the exogenous male power parameter ψ is set at two and in column (b) it is set at one. As we noted above, when bargaining power is exogenously determined, such changes would only impact the relative amount of work, consumption, and leisure but would not affect the quantity-quality tradeoff. As a comparison of columns (a) and (b) show, however, with endogenous bargaining couples agree to have fewer but relatively more educated children when ψ declines. This shift is shown to be quantitatively significant under a wide range of reasonable parameter specifications: The reduction of ψ from two to one lowers average fertility from 2.7 children per household to 2.4 children, and raises the average educational attainment of the offspring from 2.7 units per child to 3.3 units. These changes correspond to roughly a 11 percent drop in fertility and a 22 percent increase in the average education level.

In column (c) of Table 3, we present the effects of a lower gender wage gap on household choices.¹⁶ The effects on fertility and education are broadly similar to those of a reduction in the male intra-household power parameter ψ . Given our parameter choices, however, a lower gender wage gap helps to reduce fertility and raise educational attainment more than a reduction in male power through a reduction in ψ : Educational

¹⁶We have already shown in the preceding section that the quality-quantity tradeoff is independent of bargaining when couples' bargaining power is determined exogenously and all household choices are made collectively. When bargaining power is determined exogenously, it is difficult to justify theoretically why couples may choose their labor supply schedules non-cooperatively. That noted, a relevant benchmark for the results shown in columns (a) through (c) involves those generated from a two-stage, exogenous, bargaining model. Using the parameter values in column (a), a similar calibration exercise for the two-stage, exogenous, bargaining model shows the impact of endogenous bargaining on the quantityquality tradeoff: Couples have more children (6.25 per household) and educate them less (1.89 units per child). This outcome is, for the most part, a result of wives' working much less in this case compared to the endogenous case where they maintain their labor market participation in an effort to bolster their marital power.

attainment almost doubles and fertility drops by 60 percent. Obviously, this need not be the case universally. Although it is plausible that the gender wage gap and the relative institutional and legal advantages men enjoy in marriage are highly correlated, scaling back the legal advantages men enjoy in marriage can impact the quantity-quality tradeoff more if the gender wage gap is relatively small.

It is rather straightforward to establish why couples alter their fertility and education choices when bargaining power is endogenous: When bargaining power is influenced by relative spousal incomes, labor force participation becomes crucial for maintaining intra-household power. As a consequence, policies aimed at empowering women do not generate as large shifts in the labor-leisure choice as they do with exogenous bargaining. And due to the higher rigidity of the labor supply schedules with endogenous bargaining, empowerment policies lead to changes in fertility and education so as to generate more leisure time for women.

Remark 2: With endogenous bargaining power, optimum household fertility and education are influenced by the process of bargaining. In particular, the empowerment of women will raise female labor force participation and induce a shift away from quantity towards quality.

The top panel of Table 4 presents our parameter choices for our second set of simulations. Here we make two distinct modifications to parameters we utilized in the previous round: One, we no longer assume that education involves variable costs only. Instead, we let the fixed cost of attaining a given level of education, F, be strictly positive. And two, we let the human capital level of unskilled labor, λ , also be strictly positive. With these two modifications, we can explore a wider range of parameter choices than those we examined above to show specifically how improvements in life expectancy empower women.

[Table 4 about here.]

The first three columns of Table 4, (a), (b) and (c), show the effect of improvements in life expectancy on the household equilibrium. Column (a) shows results with a value of 0.5 for second-period life expectancy, p, column (b) considers a value of 1, and column (c) a value of 3. As shown, higher life expectancy generates an "income effect" and raises household consumption, spousal leisure, average educational attainment and fertility. But couples choose to devote a larger (smaller) share of the additional income generated by higher life expectancy to education (fertility). Thus, endogenizing the process of bargaining generates a higher education to fertility ratio due to improvements in life expectancy. The reason for this is identical to the one we identified above: Ceteris paribus, higher life expectancy empowers women because it raises their labor supply more than that of men. And when bargaining power is influenced by relative spousal incomes, labor force participation is essential for maintaining intra-household power. As a consequence, higher life expectancy leads to changes in fertility and education so as to generate more leisure time for women.

Remark 3: With endogenous bargaining power, improvements in life expectancy empower women and lead to higher ratios of average education to fertility.

Finally, Figures 5-13 show how household choices evolve due to changes we considered above. In Figures 5, 6, and 7, we show how direct empowerment of women equalizes couples consumption and leisure time, lowers fertility and raises educational attainment. As shown, both husbands and wives respond to lower ψ by adjusting the time they devote to work: In essence, women capitalize on additional bargaining power they gain due to lower ψ by reducing their labor supply, and men, in an effort to maintain their own marital power, raise theirs. In Figures 8, 9, and 10, we illustrate how narrower gender wage gaps affect the household equilibrium. In general, results are similar to the ones depicted in the three previous figures: Spousal consumption and leisure become more equal, educational attainment rises, and household fertility drops. Interestingly, though, a comparison of Figures 6 and 9 shows how direct empowerment of women generates pure spousal transfers of leisure and consumption (where wives' consumption and leisure go up at the expense of those of husbands'). This is, in part, why men compensate by working more in response to reductions in ψ . When women gain more marital power as a result of higher wages, couples' income goes up. This generates an income effect which benefits both spouses. Wives' consumption and leisure go up relative to their husbands', but the latter still enjoy more consumption and leisure due to higher household incomes. This is why husbands are willing to work less and lose marital power in response to narrower wage gaps—but not in response reductions in ψ . Finally, in Figures 11, 12, and 13, we show the impact of higher life expectancy on household choices. An interesting effect of higher life expectancy is that it equalizes spousal leisure much more than it does consumption. While this is due, partly, to parameter choices, it is also reflective of the fact that, holding constant the time spent on child rearing, longer life spans directly generate more leisure time for the wives.

[Figures 5-13 about here.]

Last, we explore how changes in life expectancy, the gender wage gap and the social attitudes towards gender equality together affect the quantity-quality tradeoff. Columns (d) and (e) of Table 4 present the impact of a simultaneous increase in life expectancy, and decreases in the gender wage gap and the exogenous male power parameter ψ . In setting our parameter choices with respect to life expectancy, p, and the gender wage gap, $w_m - w_f$, we rely on the data presented in Table 1. According to this data, life expectancy in the United States just about doubled between 1850 to 1990, going from roughly 39 years to 76 years. This corresponds to a minimal value for p of one and a value of two in later periods. The data also suggest that the hourly earnings of women rose from about 33 percent of that of men's in 1850 to about 66 percent in 1990. Consequently, we set women's wages at 3.3 for women in the first simulation and at 6.6 in the second

simulation (where in both simulations men's wages are normalized to 10). Finally, to account for the social progress made in generating equal gender opportunity, mostly in last three decades, we set the parameter ψ respectively at 2 and 1 in the first and second simulations. A comparison of the columns (d) and (e) show how the combination of such changes alter household choices. Women work much more relative to men and enjoy higher consumption and marital power after the changes. Men, on the other hand, work roughly the same fraction of their time endowment both before and after the changes. Although they consume much more in absolute terms, their consumption relative to that of women is now considerably lower. Men also are left with significantly less marital power. And finally, as a result of the rise in female marital power, couples have fewer but more educated children.

6. Implications and Further Discussion

The model described above has a number of specific implications, some of which we have already discussed. In this section, we highlight the major points more formally and present the supporting evidence that are relevant to each.

I) The "institutional" features of marriage directly influence economic development, because they affect the extent to which wives' choices are reflected in family decisions. This model demonstrates why marital power sharing arrangements are relevant for longrun economic performance. The biological differences between the sexes in the time requirements for parental time investment make marital decision-making an important mechanism through which the economy wide quantity-quality tradeoff is determined. This result complements those found by two strands in the existing literature. On the one hand, the role of marriage emphasized here-that of a gender bargain about quantity versus quality of offspring-introduces a new dimension through which marriage affects macroeconomic performance. A number of recent papers, including Aiyagari, Greenwood and Guner (2000), and Fernandez, Guner and Knowles (2001), show how other features of marriage, such as the process of marital matching and divorce, might be influencing economic performance through the channels of income distribution, mobility, and inequality. On the other hand, the gender bargaining feature of marriage is shown here to influence the quantity-quality tradeoff and economic development. Other work, such as Manser and Brown, McElroy and Horney, Chiappori (1988, 1992), Chiappori, Fortin and Lacroix (2002), Basu, and Rasul (2002), has identified-theoretically and empirically-the role of marital bargaining in child labor, female labor supply, and fertility.

II) Improvements in life expectancy empower women. Because men and women differ in the biological requirements of child rearing, life expectancy plays a crucial role in determining how marital choices are made. And as shown, bargaining influences not only the quantity-quality tradeoff but also the labor supply of men and women, and the relative role of women at home and in economic activities. Specifically, the model identifies that improvements in life expectancy diminish the relative biological disadvantage of women in child rearing, and thus help to reduce the gender gap in labor incomes. As a consequence of higher life expectancy, women's contribution to net household income rises. This, in turn, gives women a greater say and share in household choices. The shift in the marital balance of power-in and of itself-is shown here to be stimulative for growth and development. Thus, an important novelty of this framework is to identify an indirect and gender-specific channel through which life expectancy affects economic growth.¹⁷

III) Cultural and ideological factors related to gender equality alter the process of development via their impact on intra-household gender power. Higher life expectancy reduces the relative amount of time women spend rearing and educating their offspring and raises wives's leverage in marriage. With endogenous bargaining, this higher leverage manifests itself in an increase in wives's leisure time. Given the biological gender disparity in the time cost of child rearing, women attain higher leisure time, in part, by influencing the couple's quantity-quality decision more heavily.

This analysis highlights why the extent to which economies are culturally or ideologically predisposed towards gender equality is important.¹⁸ As we have shown in the preceding section, the existence of cultural or ideological obstacles to a shift in household gender power will limit the impact of improved life expectancy or a narrower wage gap

¹⁷For studies that identify and/or quantify the role of health (or life expetancy) on economic growth, see for example, Bloom, Canning, and Sevilla (2001), Kalemli-Ozcan, Ryder, and Weil (2000), and Weil (2001).

¹⁸This result complements those discussed in Landes (1998, 2000) by identifying a gender- and household-centric approach to why culture and ideology should affect economic development.

on economic development.¹⁹

IV) The gender income gap is influenced by life expectancy. The historical evidence seems to suggest that the role of women in marriage and the economy follow a U-shaped trajectory during the course of development. The framework develop above, identifies that both are influenced to a great extent by changes in life expectancy. And in doing so, the model demonstrates that the interaction among life expectancy, marital bargaining and gender power help to alter the process of economic growth and development.

7. Conclusion

During the last two decades, economists have recognized and examined the role of intrahousehold bargaining in various microeconomic phenomena pertinent to the process of development, such as family and female labor supply, child labor and pecuniary and nonpecuniary intra-marital transfers. A departure from the unitary model of the household can be rewarding for exploring the sources of modern economic growth as well, because of the inherent biological differences between the two sexes in the requirements of parental time investment. These differences form the basis of a potential marital conflict over optimal fertility and the quantity-quality tradeoff.

This paper identifies an important-but previously unreported-link between the evolution of marital gender power and long-run macroeconomic performance. What yields such a link is the combination of labor-leisure choice with endogenous gender power based on relative spousal earnings. Together they render transfer payments ineffective in fully compensating a worse-off spouse because leisure time is not easily transferable when such transfers affect the household balance of power. As a consequence, shifts in the household balance of power entail changes in fertility and educational attainment.

Our approach shows that the biological differences between the sexes in the time

¹⁹At face value, the historical experience of some East Asian economies seem to contradict the notion that cultural attitudes towards marital gender equality may be important for economic growth and development. That noted, many if not all, male-dominant, Asian countries which were successful economically in the post-World War II era, also attach relatively high value to educational attainment. In the framework of the model presented above, male-dominance due to cultural factors would be captured by smaller θ and θ' , and a greater emphasis on educational attainment would be linked to lower α . While the first effect would hinder economic growth, the second one would stimulate it.

requirement for child rearing in a bargaining framework makes the combination of marriage, health, and culture an integral part of economic development. First, marriage is an important institution related to economic development because the extent to which wives' choices are reflected in couples' decisions affects population growth and educational attainment. Second, improvements in life expectancy empower women, reduce the gender income gap, and affect the processes of growth and development. And third, the degree to which an economy is culturally predisposed towards gender equality can be important.

8. Appendix

8.1. Proof of Remark 1:

Using the first-order conditions given by (6), (7) and (8), we establish the following:

$$w_m l_m = \frac{c_m}{\alpha},\tag{A.1}$$

$$w_f l_f = \frac{\bar{\theta}}{1 - \bar{\theta}} \frac{c_m}{\alpha} \tag{A.2}$$

and,

$$c_f = \frac{\bar{\theta}}{1 - \bar{\theta}} c_m. \tag{A.3}$$

Expanding and re-arranging the budget constraint given by (4), we have

$$c_f + c_m + w_f l_f + w_m l_m \le p(w_f + w_m) - e(F + zn).$$
 (A.4)

Substituting in (A.4) for $w_m l_m$, $w_f l_f$, and c_f , we get

$$c_m = \frac{\alpha}{1+\alpha} (1-\bar{\theta})[p(w_f + w_m) - e(F + zn)].$$
 (A.5)

Let $\Pi \equiv p(w_f + w_m) - e(F + zn)$. Now, substituting (A.5) for c_m in the first-order conditions for n and e, given by (9) and (10), we have

$$\frac{\beta}{n} = \frac{(1+\alpha)(\tau w_f + ze)}{\Pi}$$
(A.6)

and,

$$\frac{\gamma\phi}{\lambda + \phi e} \leq \frac{(1+\alpha)(F+zn)}{\Pi} \tag{A.7}$$

(A.6) and (A.7) are both independent of $\bar{\theta}$ and they both relate *n* to *e*. Hence, optimal fertility and education are independent of the bargaining parameter $\bar{\theta}$. Using (A.5), we can now establish

$$\frac{\partial c_m}{\partial \bar{\theta}} = -\frac{\alpha \Pi}{1+\alpha} . \tag{A.8}$$

Together with (A.1)-(A.3), (A.8) implies that

$$\frac{\partial c_f}{\partial \bar{\theta}} = \frac{c_m}{(1-\bar{\theta})^2} - \frac{\bar{\theta}}{1-\bar{\theta}} \frac{\alpha \Pi}{1+\alpha} , \qquad (A.9)$$

$$\frac{\partial l_m}{\partial \bar{\theta}} = -\frac{1}{w_m} \frac{\alpha \Pi}{1+\alpha},\tag{A.10}$$

and,

$$\frac{\partial l_f}{\partial \bar{\theta}} = -\frac{1}{w_f} \left\{ \frac{c_m}{(1-\bar{\theta})^2} - \frac{\bar{\theta}}{1-\bar{\theta}} \frac{\alpha \Pi}{1+\alpha} \right\}.$$
 (A.11)

It is then straightforward to show that the sum of (A.8) and (A.9) and the sum of (A.10) and (A.11) both equal zero.

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Figure 2: Spousal Response Functions and Changes in ψ



Figure 3: Spousal Response Functions and Changes in w_f/w_m



Figure 4: Spousal Response Functions and Changes in \boldsymbol{p}



Figure 5: Labor Supply and Changes in ψ

Figure 6: Consumption, Leisure and Changes in ψ



Figure 7: Fertility, Eduation and Changes in ψ



Figure 8: Labor Supply and Changes in w_f/w_m



Figure 9: Consumption, Lesiure, and Changes in w_f/w_m



Figure 10: Fertility, Education, and Changes in w_f/w_m





Figure 11: Labor Supply and Changes in \boldsymbol{p}

Figure 12: Consumption, Leisure, and Changes in p



Figure 13: Fertility, Education, and Changes in \boldsymbol{p}



Year	Life Expectancy	WLFPR		Earnings		
	(years)	(percent)		(percent of men's hourly w.)		
		married	single			
1820				34		
1832				44		
1850	38.5			48		
1880	40.5			54		
1890	46.8	4.6	40.5	54		
1900	51.8	5.6	43.5	56		
1914				58		
1920	57.4	9.0	46.4	57		
1930	60.8	11.7	50.5	58		
1940	64.9	13.8	45.5	54		
1950	69.0	21.6	50.6			
1960	70.7	30.6	47.5	54		
1970	71.6	39.5	51.0	57		
1980	74.5	50.1	61.5	59		
1990	76.1			66		

Table 1: U.S. Life Expectancy, Gender Gap, and Labor Force Participation Rates*

* Compiled from Goldin (1990) and Haines and Steckel (2000).

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Income Group		Primary Education		Secondary General		Secondary Vocational	
		percent female		percent female		percent female	
		1980	1993	1980	1993	1980	1993
Low Income		42	44	36	41	30	31
Middle Income		47	48	46	49		
	Lower Middle Income	47	48	45	49		
	Upper Middle Income	48					
Low & Middle Inc.		43					
	East Asia & Pacific	45	47	40	44	33	45
	Europe & C. Asia	49	49	53	52		
	Latin Amer. & Carib.	49					
	Middle East & N. Afr.	41	46	37	45	24	30
	South Asia	38	41	31	38	27	15
	Sub-Saharan Africa	42	44	34	41		
High Income		49	49	49	49		

* Compiled from World Development Indicators, 1997, The World Bank.

Parameters	(a)	(b)	(c)
au	0.1	0.1	0.1
α	1	1	1
β	1	1	1
γ	0.65	0.65	0.65
z	0.5	0.5	0.5
w_f	5	5	10
w_m	10	10	10
Life expectancy:			
p	1	1	1
Gender Inequality:			
ψ	2	1	2
Education Premium:			
ϕ	1	1	1

Table 3: Parameter Specifications and Simulation Results (with $F=\lambda=0)$

Variables	(a)	(b)	(c)
s_f	0.58	0.55	0.59
s_m	0.56	0.58	0.49
θ	0.21	0.32	0.38
l_f	0.16	0.22	0.21
l_m	0.44	0.42	0.51
c_f	1.13	1.93	3.03
c_m	4.38	4.06	5.04
n	2.65	2.35	2.00
e	2.70	3.32	5.35

Parameters	(a)	(b)	(c)	(d)	(e)
au	0.05	0.05	0.05	0.05	0.05
α	1	1	1	1	1
β	0.6	0.6	0.6	0.55	0.55
γ	1	1	1	1	1
2	0.05	0.05	0.05	0.05	0.05
F	0.1	0.1	0.1	0.1	0.1
λ	1	1	1	1	1
w_f	5	5	5	3.3	6.6
w_m	10	10	10	10	10
Life expectancy:					
p	0.5	1	3	1	2
Gender Inequality:					
ψ	2	2	2	2	1
Education Premium:					
ϕ	1	1	1	1	1
Variables	(a)	(b)	(c)	(d)	(e)
S_{f}	0.27	0.55	1.74	0.52	1.18
/	0.90	0.50	1 77	0.00	1 1 7

Table 4: Changes in Life Expectancy and Education Premium (with F > 0 and $\lambda > 0$)

Variables	(a)	(b)	(c)	(d)	(e)
s_f	0.27	0.55	1.74	0.52	1.18
s_m	0.30	0.59	1.77	0.62	1.15
θ	0.19	0.19	0.20	0.12	0.40
l_f	0.13	0.33	1.12	0.37	0.72
l_m	0.21	0.41	1.23	0.38	0.85
c_f	0.43	0.87	2.73	0.49	4.65
c_m	1.90	3.74	11.11	3.56	6.86
n	2.00	2.49	2.82	2.35	2.02
e	10.7	19.5	56.4	17.6	56.3